METERING OF LOS ANGELES[1]

By George Read[2]

On February 4, 1902, the municipality of Los Angeles purchased the properties of the old City Water Company. At this time the city was growing rapidly and the water supply was, if anything, diminishing due to a cycle of dry years. The average rainfall for this section of the country is about 16.5 inches, but prior to this date the rainfall was as follows: 1897–8, 7.06 inches; 1898–9, 5.5 inches; 1899–1900, 7.91 inches; 1900–1, 16.09 inches, 1901–2, 10.6 inches, making an average rainfall of 9.44 inches for these five successive seasons.

The daily per capita consumption at this time was 300 gallons, about twice as much as it should be, and something had to be done quickly to conserve the available water supply. After considerable discussion it was decided that the only practical way to conserve the water supply was by the installation of meters.

At the time the works were taken over there were 319 metered services supplying livery stables, laundries, wineries, the oil fields and a few lodging houses. These were under a meter rate because it was hard to set a proper flat rate.

As an opening wedge, meters were set on residences where the irrigated grounds exceeded two and one half times the area of the buildings. For a short time there was considerable opposition. The business section was next given attention, and here the greatest saving was made as the plumbing, in most cases, was found in deplorable condition. Next the meters were set in those districts supplied with pumped water. From then on up to the present time meters have been set as fast as funds and time would permit. There are still 2500 services to meter. In 1912, ten years after the works were purchased, a study of consumption through 41,177 metered services showed a maximum per capita daily of 147.9 gallons for July and a minimum of 92.35 gallons for March. The

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average daily per capita for the year was 118 gallons. These results were based on five persons per service, which was very close to being correct at that date.

Los Angeles always will have a higher per capita consumption than most eastern cities on account of it being a city of lawns and shrubbery which need watering about ten months out of the year. This per capita referred to covers metered services only. There is considerable water used outside of these for street washing, parks, fires, sewer flushing, municipal building, etc., and today this combined is estimated to make an average daily per capita consumption of 130 gallons, and reaches a high peak at times of 160 gallons. Due to the increase of apartment houses the number of consumers per service today is about 5.4.

During the first five years of public ownership of the water works, the city purchased several makes of meters, and from knowledge gained during this time the first set of specifications covering water meters for the city was written in March, 1907. From then on specifications have always been written and every improvement that would be advantageous to the City in prolonging the life of the meter has been embodied in these specifications.

In March, 1908, the Department purchased two $\frac{5}{8}$ inch meters of all the different makes that could be had, and commenced a durability test. (The reason of the $\frac{5}{8}$ inch size being chosen is that about 92 per cent of the meters in service are of that size.) These meters were thoroughly tested before placing for the test, on two flows, one at the rate of two cubic feet per minute, and one at the rate of ten cubic feet per hour. They were then run steadily, night and day, at the rate of one cubic foot per minute, one half their rated capacity. This rate was chosen so that no manufacturer could claim that the meters were being run beyond their rated capacity.

When the meters reached a registration of 25,000 cubic feet, they were taken off the line and again tested on the two flows, two cubic feet per minute and ten cubic feet per hour. The next test was made at 50,000 cubic feet recorded, the next at 75,000, and so on until the meter reached a registration of one million cubic feet. The meter was then taken off the line, overhauled and made practically as good as when new. All the parts, etc., that were necessary to make the meter practically as good as when new plus the parts, etc., that were needed to keep the meter running to reach a registration of one million cubic feet, were charged up to the meter.

It took about two and one-half years to complete this test, and by means of it several weak spots were overcome. A meter under this kind of a test does not show the effects of corrosion as it would have if it had been in actual service, because water passing through the meter continuously tends to retard corrosion. Also the wear throughout the meter is not as great as if it had been in actual service, because the meter is running continuously at a steady pace and not subjected to hydraulic shocks through turning off and on all the time.

All the makes of meters were working, however, under the same conditions, and the showings made were quite different in some cases. We consider that the knowledge gained paid well for the time and trouble and today we are still testing the same way.

TYPES OF METERS USED FOR DIFFERENT KINDS OF SERVICE

Disk piston meters are used from $\frac{5}{8}$ inch to 2-inch inclusive. For large office buildings, etc., requiring 3- and 4-inch meters, where the consumption as a rule is steady and where sensibility is the important factor, an oscillating piston type of meter is used. So far this type of meter has given the City the best service for this kind of use. It is expensive but dependable. Large services for fire protection, supplying only sprinkling systems, are not metered.

We consider it an imposition upon the consumer to install at his expense a large costly meter which might do harm and certainly do no good as far as the consumer is concerned. We insist on the piping from fire services being entirely separate from the domestic supply and we endeavor to inspect these services yearly, by shutting off the domestic supply and going through the premises. If we find water anywhere, it must be coming from the fire service. To date we have found only one case where this was really abused, and in that case the department imposed a pretty stiff penalty.

Services supplying sewer flush tanks are being metered with Jet meters as fast as time and funds will permit. We have 4600 of these connections, including San Pedro, and at this date 2723 are Jet metered.

The water is discharged into the tank through a hard vulcanized rubber disk and is calibrated to discharge as nearly as possible 300 gallons in twenty-four hours. It is practically impossible to make the calibration perfect for this amount in a given time, due to pressure variation.

There are several good water meters on the market today and, in fact, all meters are better than they were a few years ago. Nevertheless the Department finds it good policy to standardize on as few makes as possible. The meter repairmen become more efficient, repair parts can be more intelligently ordered in advance, changeability of meters in service is assured, and the meter shop can be properly equipped for repairing.

METHOD OF METER SETTING

As we are not bothered with freezing, our meters as a rule are set just inside the curb. They are placed on a riser from the service so that the face of the register is about 3 inches from the surface. This makes the reading of the meters and the changing of inactive meters, etc., easy and quick, and it also allows the use of an inexpensive shallow meter box.

We have a local building ordinance which prohibits basements under sidewalks extending further than 3 feet from the curb. This strip was reserved by the City for the installation of fire plugs, meters, electrical conduits, and other public utility equipment.

We have a few meters in basements where the basement extends to the curb. These basements were made prior to this ordinance. The few that we have are a nuisance. The meter-readers must get permission to enter, hunt keys and carry flash lights. Stuffing boxes are likely to leak and to cause damage. There is also a likelihood of a meter bursting and causing a great deal of damage.

When a large service must be metered in a basement we prefer a battery of 2-inch all bronze meters with valves governing the inlet and outlet of each meter. We consider a 2-inch all bronze meter not near as likely to burst as a 3 or 4-inch meter with main casing made of cast iron. In addition, if one meter stops operating it can be changed without shutting off the entire supply. Batteries have advantages and also disadvantages.

On services supplying large industrial plants, where at times it would be inconvenient and costly to the consumer to have the water cut off while changing the meter for repairs, we place a valve on each side of the meter and run a bypass pipe equipped with a valve around the two valves governing the meter. The bypass valve is left closed and sealed and when it is necessary to change the meter for repairs, etc., we open this bypass valve and then close the two valves governing the meter, thereby not interrupting the service.

METER COVERS

For covering meters in parkings, lawn or no lawn, a cement meter box 9 inches square by 11½ inches deep, is used—what we call our no. 1 meter box.

This box does not cover the curb cock and in fact we try to discourage the using of curb cocks by the consumer and recommend that they have a wheel valve placed by a plumber to control their water supply in case of needed repairs to leaky fixtures. The reason we try to discourage the consumer from using the curb cock is that in many cases they ruin them and frequently leave a hole dug out in front of the meter box which is a menace to the public.

We have specifications covering our curb cocks from ½ to 2-inch and they are standard all over the system. If any curb cock has to be renewed the space for the setting of the meter is retained. We also have a standard (fool proof) locking device for our curb cocks. By fool proof we mean that no curb cock can be clamped and sealed unless it is closed. Just before the world war broke out we were intending to cover meters in well kept lawns with a concrete meter box large enough to cover meter and curb cock both, and we still intend to do this when times get back to normal.

For housing meters set in cement walks we use a concrete well and a cast iron plate, large enough to house the meter and the shut off. A wooden form made from 1 x 12 R. O. P. rabbited ¾ x ¾ is set in position and concrete poured around it. The plate then rests on the wooden form while the concrete is setting. Three sizes of plates are generally used as follows:

For covering ⅝ to 1-inch meters, the plate is 23½ x 15¾ inches, weighs 60 pounds and costs at this date $3.00 each. For covering 1½- and 2-inch meters, the plate is 30 x 22 inches, weighs 121 pounds and costs $6.00 each. For covering 3- and 4-inch meters, the plate is 46 x 26 inches, weighs 180 lbs. and costs $9.00 each. We also have a large plate, 64 x 26 inches, which we use at times to cover a fire-service gate and domestic meter.

When a sidewalk is being extended to the curb, taking in small concrete meter boxes that do not cover the curb cock, the Department requests the contractor to leave the top of the boxes level with the surface of the new walk and cement around them. Later on when the walk is thoroughly set, and it is convenient to the Department, a meter plate according to the size of the meter is laid on the sidewalk square with the curb, so that the meter register

comes in the center of the plate. A hole in the sidewalk is then cut about a quarter of an inch larger than the plate, taking care not to crack the walk outside of the mark. The hole is excavated to about 3 inches below the bottom of the meter and the sides and ends of the hole extended about 2 inches under the walk. After the bottom of the hole is tamped, a wooden form is set covering the meter and the cut off. The plate is then set on the form and tamped down until the top of the same is level with the sidewalk. The plate is then removed and concrete is grouted all around the form to the surface. The plate is then put back and rests on the form while the concrete is setting. In time this wooden form rots away and leaves the plate resting on the concrete. A hole is left in the ends of boxes in case piping to meter has to be renewed.

This method of setting meter boxes and plates eliminates the cost of resurfacing, matching colors, covering while setting and gathering covers.

METER TESTING

Meters are tested before they leave the factory, but to make sure they are correct the City again tests all meters before they are set. Our shop is equipped with three round galvanized iron tanks 22 inches in diameter by 4 feet 11 inches high for testing meters from $\frac{5}{8}$ to 2-inch. Each tank is equipped on the outside with a $\frac{3}{4}$-inch O. D. glass tube, running the entire height of the tank. These glass tubes are equipped with buret floats on account of capillary attraction of water and graduated in three stations, viz., beginning point, 5 cubic feet, and 10 cubic feet, which is stopping point. These buret floats have projections to keep them from adhering to the glass tube, and contain enough quick-silver to about half submerge them. The inlet is at the bottom of the tank and the piping is so arranged that the head of water is killed when entering the tank, allowing it to rise steadily in the glass tube, so when whipped off at any flow it remains still. The 5- and 10-feet stations are determined by weighing the water into the tank at $62\frac{1}{2}$ pounds per cubic foot, so when a meter is tested the water is practically weighed through the tank readings.

These tanks were made tall and small in diameter to insure a big displacement for a small amount of water. Each tank is used to test four to five meters at a time by connecting them together with meter couplings. These meter couplings are joined together with a

tee equipped with a lever handle valve for running each meter up to an even figure.

The register boxes of all meters are sealed after testing and no meter is taken from the meter shop for setting unless it is sealed.

We also have a large reinforced concrete tank 13 feet 10 inches square on the outside. This tank is divided into three sections. One section contains 900 cubic feet, one, 100 cubic feet, and one, 10 cubic feet. It is also equipped with a glass tube and buret float and is used for the testing of larger meters, etc.

During the last fiscal year the Department tested an average of 2000 meters per month.

Our testing tanks are kept clean and are satisfactory in every respect.

METER REGISTRATION

A great many people really believe that water meters rob them by over-registering, and request that their meter be tested. We explain and try to talk them out of having it done, but sometimes the more we explain the more determined they are to have the test made. We then take their order and request that they or someone witness the test and tell them that if we find the meter over-registering, that there will be no charge for the test, and that we will rebate the back bills already paid. The charge for testing is as follows: $\frac{5}{8}$ to 1-inch, \$1.50; $1\frac{1}{2}$- to 2-inch, \$2.50; 3- and 4-inch, \$5.00; 6- and 8-inch, \$6.00.

The $\frac{5}{8}$- and 1-inch as a rule are tested at the premises, by shutting off the water, taking the meter out and connecting it to the curb cock with a piece of hose. Then a meter of known registration on variable flows equipped with a valve on the outlet side is connected to the meter to be tested. Larger sizes are taken to the shop to be tested, leaving a new meter in its place, and if the meter being tested is low in registration or needs any repairing it is not put back. In twenty years of experience I cannot recall over two cases where meters were found over-registering enough to warrant any rebate and those were very small.

We have yet to test a new meter that will describe an absolute straight line on variable flows. There is always a flow which shows a high peak of registration; because at this particular flow the meter is more positive in displacement than at any other; it does not show show a loss through sensibility or a slippage by over-running. At

high peak registration flows we aim to test and gear our meters and they usually leave the shop recording 98 to 101 per cent.

When a disk piston meter is new, one complete nutation or gyration of the disk means the passage of a quantity of water equal to the effective volume of the chamber. Any slight slippage due to the piston not perfectly fitting the chamber is taken care of by the change gears.

After this meter has been in service for a few months and the draft has not been high and the water has been free from grit, etc., there appears a deposit of slick vegetable matter on the piston, and all over the inside of the measuring chamber. This deposit tends to lessen slippage and slightly reduce the quantity of water displaced by each nutation of the disk, hence the meter shows a slight increase of registration.

This kind of a deposit acts as a lubricant and tends to prolong the life of the meter. The increased registration through the meter is negligible and, as a rule, short lived, and the consumer has nothing to fear in this respect. On every meter that was taken out for not operating, due to being worn out, it is safe to say that the consumer got more water than he paid for.

The Department has some meters in service equipped with straight reading intermittent registers that require close watching. Most of these meters were acquired through the taking over of water companies by the City. This type of register can over-register at times, by one of the mutilated gears creeping back on its shaft and getting on the face of the counter wheel which drives it. This gear then becomes disengaged from the next higher counter-wheel which it should drive and leaves it free. The first counter wheel is fastened on the shaft that the other wheels revolve upon and as this shaft revolves the disengaged counter wheel at times creeps with it.

This intermittent straight reading register is gradually being replaced with the round dial constant moving type. This faulty construction, well known to us, is closely watched and before long will be a trouble of the past. If the consumer knew how careful the department is in regard to the testing of meters before they are set and what a remote chance there is for his meter to over-register I think he would be perfectly satisfied. Of course, there is always a chance of the meter being over-read by the meter reader and most of these are caught before billing.

METER REPAIRING

Practically all meter repairing is done at the meter shop. The only work done in the shape of repairs to meters in the field is the renewing of registers that have been broken. Main casings of our velocity meters are left on the service. The cover containing gear train and register is removed and the cage containing propeller is taken out. These parts are then replaced with new ones and the old parts are brought to the shop for repairs. This eliminates a lot of hard and costly work. Our facilities for repairing and testing meters are very good. The shop contains concrete benches for testing, repairing and storing the meters ready for setting. The machinery consists of a lathe, pipe threading machine, wire wheels for cleaning the outside of meters and exhauster for carrying away the dust, grind stone and carborundum wheels, circular saw for cutting lumber for meter box forms, ball socket machining machine, gages, press diaphragm cutter, etc. The machinery is run by six induction motors. Our force consists of a superintendent who passes on meter parts, whether they are to be repaired or wholly replaced, and sees that every meter is properly repaired (not tinkered with). He also takes care of all repairs to service equipment.

Under him are two testers, a machinist (considered a meter repairer) and five meter repairers. A chief clerk and assistant make permits for street excavations, check meter and service work done against daily time cards, make monthly inventory of meters in stock for Los Angeles, San Pedro and San Fernando Valley, post maintenance cards, order, receive and record meter and service supplies, make monthly reports of all meters set and check these with office records, and are responsible for all meters leaving the shop. On September 1, there were 126,052 meters in service, which at this date means one meter repairer for each 21,000 meters in service. The Department takes out monthly about one meter for every two hundred in service for not operating, due to all causes.

In the last twelve months 161 meters were taken out monthly for failure to operate, due to hot water or steam backing up from boilers or heaters. On the first occurrence of a meter being damaged by hot water or steam supplying a residence, a post card is mailed the consumer, notifying him and requesting that care be taken to guard against a similar occurrence. On the second occurrence, a bill is rendered the consumer covering the cost of changing and repairing

the meter. When meters are likewise damaged, supplying places of business, a bill is rendered on the first offence. The Department advises consumers to watch their heaters and not to use a check valve on their service, as it is cheaper to pay for repairing meter than to run the risk of bursting a boiler.

The organization of the Meter and Service Department consists of a general superintendent with four assistants. One has charge of the field meter and service operation and office meter and service records. The second has charge of meter and service installation and service maintenance. The third has charge of all meter repairing and upkeep of service equipment and the fourth receives, records and distributes service orders and is a general assistant.

The total force of the meter and service department at this date consists of 105 men, and they cover Los Angeles, San Pedro, San Fernando Valley and the West Gate District.

The city of Los Angeles was incorporated on April 4, 1850, and at that date its total area was 28 square miles. Today it covers an area of 366 square miles, a square mile for every day in the year.

The new domestic service installations for the last twelve months, covering all districts, have been at the rate of 1025 per month, and today show no signs of falling off.

On September 1, 1921, we had 136,970 services of all kinds and 123,052 meters. We have also a little over 3000 irrigation services and meters in the San Fernando Valley, which makes a total of 126,052 meters to maintain.